DOCUMENT RESUME

ED 107 348 PS 007 836

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TITLE Crystallizing Conditions, Developmental Advance and Education. First Annual Report.
SPONS AGENCY Spencer Foundation, Chicago, Ill.
PUB DATE 31 Dec 74
NOTE 18p.

EDRS PRICE MF-$0.76 HC-$1.58 PLUS POSTAGE
DESCRIPTORS *Children; *Conceptual Schemes; *Developmental Psychology; Diagnostic Tests; Generalization; *Learning Processes; Longitudinal Studies; Map Skills; Maturation; Models; Objectives; Research Design; *Research Projects; Spatial Relationship; Thought Processes
IDENTIFIERS *Crystallization (Psychology)

ABSTRACT

This research report outlines progress made in the development of a conceptual framework (called "crystallization") which is intended to explain the conditions found to be critical to the child's potential for developmental change. The research completed and proposed on crystallization has centered around four main areas of activity: (1) a field experiment, (2) the development of a diagnostic map-drawing instrument, (3) the preparation of a series of theoretical and conceptual papers, and (4) a proposed study of "precociousness" in children. The overall research goal is an attempt to operationalize, or put into explicit language, the specific conditions under which developmental advances take place, especially advances which would probably not occur without educational assistance. Each activity undertaken in the project was selected for its probable contribution to this objective and is described separately in the report. (CS)

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FEB. 1 0 1975

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First Annual Report

Crystallizing Conditions, Developmental Advance and Education

by

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PS007836

Submitted to the Spencer Foundation
H. Thomas James, President

31 December, 1974

09002

Crystallizing Conditions, Developmental Advance, and Education: A Report Submitted to the Spencer Foundation

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The project began in January of 1974 with the intention of carrying out research and development bearing on a conceptual framework which I have called crystallization. My purpose in this report is to bring the Spencer Foundation up to date on where we have come thus far, and to outline what we plan to do in the next year of the project's funding.

In the document submitted to the Spencer Foundation in the Fall of 1973, I proposed to carry out research on the effects of the introduction of new information on the developmental level of the child. Although by no means unique in this aim, our approach had certain distinct features which set it apart from others. First, while we recognized both the importance of maturational forces in the timing of developmental changes, and the inevitability of some of these changes, we nonetheless argued that systematic exposure to bodies of knowledge and skill was critical to the child'd potential for developmental advance. In this connection our view explicitly included the assumption that some kind of exposure in a systematic way to the tools, techniques and ways of representing reality used by a culture is a prerequisite for optimal development.

Ours also differs from other views in its attempt to operationalize, or put into explicit language, the specific conditions under which developmental advances take place. In doing so, we hope to be able to give specific guidance to those who are responsible for the education of children. One of the drawbacks of the Piagetian approach, with all its virtues acknowledged, is that it does not address the specific issues

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of what to teach and when to teach. We attempt to deal with these issues by looking for and analyzing domains of knowledge and skill that, on one hand, are broader than the specific facts that have traditionally been included in curricula, and on the other hand are more specific than those broad developmental phenomena generally assumed to occur regardless of environmental conditions.

As we said in our original proposal, we hope to achieve through this line of research and development a set of reasonably clear and explicit implications for curricular planning and instruction, gathering evidence bearing on the conditions under which developmental advance takes place. It is our belief that the study of transitions in development, transitions of all sorts, offers a promising avenue toward the illumination of the conditions under which optimal development takes place. It was in this spirit that we began our work, and it is against the very demanding criterion of increased understanding of developmental process that we assess our own developmental progress.

Needless to say we have made only a very modest beginning toward the achievement of our goals during this first year of research. Still, we feel that significant steps have been made in all the domains which we proposed to explore: we have carried out a major empirical study dealing with the conditions under which developmental advance takes place; we have produced a practical instrument for the diagnosis of developmental level within a domain that is valuable in our culture; and we have completed two conceptual papers that further elaborate our thinking about the conditions under which advances in thought take place. We have, in addition, made some decisions about how to proceed from this point forward.

09091

Each of these areas of activity will be discussed separately, after which I will try to discuss how they relate to the framework of crystallization. An appendix presents the budgetary and practical aspects of our project (see Appendix A).

The Field Experiment.

As indicated in the introductory paragraphs, we have completed a study of transitions in spatial reasoning development. Our rationale for doing research on transitions using a Piaget based developmental sequence, even though (as argued elsewhere) Piagetian sequences are not those of primary interest to us, is that there is so little known about developmental sequences that are not Piagetian. Starting from this vantage point, we attempted to make more explicit and detailed a series of steps in a Piagetian sequence judged to be as close to our notion of a "culturally crystallized skill" as we could find. The task we chose was map drawing, used by Piaget as an indicator of spatial reasoning development, but also an achievement clearly dependent upon cultural influence. Basically, our empirical work during the past year attempted to study transitions in map drawing levels. Our hope was that as we learned more about general developmental sequences such as those that are described within a Piagetian framework, the same principles that pertain to Piagetian developmental advance apply to less spontaneously achieved developmental sequences.

Spatial reasoning in general, and map drawing in particular, may be seen as culturally influenced in a number of ways, a fact which Piaget acknowledges but does not consider important (Piaget and Inhelder, 1948; Piaget, 1971). For our purposes, the developmental sequence that pertains to map drawing was a reasonable compromise. In other words, even though

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the culturally evolved aspect of the discipline of map construction is of little relevance to Piaget, it was of great interest to us. We hope to identify other developmental sequences in other domains which are valued within the culture and which also have broader developmental implications, but none were available. Relatedly, our colleagues at Harvard Project Zero have begun to study developmental sequences in the expressive arts; these studies may provide the kinds of sequences we seek to study in the future.

The purpose of this field experiment completed under the direction of Samuel Snyder was to investigate the conditions under which developmental advance takes place within the domain of spatial reasoning development. In particular, the study focused on developmental shifts in children of the same age but who showed different developmental profiles. We were able to diagnose and predict with reasonable precision the conditions under which developmental advance takes place in this domain. Among a group of students, all of whom were the same age and at the same general developmental level at the outset of the experiment, individuals were found to vary in their "readiness" for developmental advance. A full report of this study is appended to this report (see Appendix B, Snyder & Feldman, in preparation).

The basic idea of the study was to operationalize two concepts in the developmental literature that pertained to transitions and to examine their interaction. These concepts were "internal" and "external disequilibration" (Strauss, 1972). Internal disequilibration refers to the range of developmental levels across which the child tends to respond to various problems in a map drawing task. External disequilibration refers to the extent to which information provided in an instructional

00006

setting differs from the general developmental level at which the child attacks the map drawing task as a whole. It was the planned variation in these two sets of variables that made up the experimental design of this study.

One prediction was that the greater the amount of internal disequilibrium, the greater would be the amount of change or development to occur. In addition, we predicted that the optimal discrepancy between the child's developmental level and information from the environment was one step or level in advance of where the child tended to respond. Thus, our most precise prediction was that children who exhibited high internal disequilibrium (i.e., a great dispersion of responses across levels), and those who were put into an instructional situation where the environment was optimally discrepant (i.e., one level in advance of their present level), would be those most likely to shift ahead in developmental level.

While the results contain a number of ambiguities, in general they supported our predictions rather well. Among a group of about seventy fifth-grade students, all of whom were at the same general developmental level at the beginning of the experiment, those with high internal disequilibration and who received treatments one and two levels in advance of their initial level achieved developmental advances substantially more often than other subjects.

Although the results of the field experiment were encouraging, they leave us with a number of unanswered questions. One problem is that our results were based on a sample of children who were studied over a relatively short period of time. What we don't know from the study is whether the developmental picture that we have constructed through the cross sectional analysis of data will occur naturally over a longer

period of time in a single child. In other words, what we are hoping to establish is what might be best conveyed as a speeded up motion picture of a very slow process, somewhat akin to films of a flower blossoming. At this moment, our results present us with a series of "still photographs" which can be ordered into a plausible developmental sequence, producing a suggestive but not well established sketch of the process of developmental change.

Therefore, a longitudinal study of developmental changes in children somewhat younger, of the same age, and somewhat older than the children in the field experiment seems indicated. Samuel Snyder, now of Bryn Mawr College, intends to carry out this longitudinal study over the next 12 to 36 months. Our project will provide start-up support for Dr. Snyder in this venture, with the aim and purpose that he will secure outside funding to complete the study.[1]

It is appropriate to mention once again that our approach to the problem of developmental transitions has been to compromise on two fronts. By choosing to investigate a developmental sequence that is Piagetian in its origin, we have chosen a domain somewhat more general and less influenced by environment than we eventually hope to investigate. And second, we have chosen to look at micro-genetic changes over a short period of time in groups of children with different developmental

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[1] We have also agreed to support a study to be carried out in Israel by Leorah Wellner under the supervision of Dr. Gavriel Salomon of Hebrew University. This study was designed during a visit (supported by Foundation funds) by the Principal Investigator to Dr. Salomon's project. The study attempts to incorporate some of our ideas about crystallization into an existing, larger research program on the effects of media on thinking. The purpose of the study is to assess the effects of fragmentation of space in a film sequence on children's ability to organize and arrange space in a map drawing. The hypotheses of this study follow closely from those of Samuel Snyder's field experiment.

profiles rather than look at the same children over a longer period of time. Our next step is to do the longitudinal research that now seems justified on the basis of our field experiment.

The compromise with the Piagetian developmental sequence is a more difficult one to overcome. Insofar as a Piagetian developmental sequence can be seen to fulfill the requirements of a culturally evolved body of knowledge and skill, map drawing and map understanding appear to be as good as any. Until more is known about other important developmental domains, we feel that we are limited to those domains which have been described by Piaget.[2]

The Diagnostic Map-Drawing Instrument.

Largely as a by-product of our field experiment we have produced a diagnostic instrument that provides a developmental level index and a measure of developmental dispersion, both based on a child's map drawing protocol. The map drawing task is a prototype for what we hope will be an array of instruments based on our conceptual framework. During the funding year, the map drawing instrument was refined by Samuel Snyder and his co-workers. A manual for the administration and scoring of this instrument was produced during the summer and fall months by Cheryl LaRossa, Samuel Snyder and David Feldman. The manual is appended to the present report (see Appendix C, Snyder, Feldman & LaRossa, 1974).

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[2] As mentioned earlier, there are some encouraging signs that colleagues have begun to establish developmental sequences in culturally relevant domains other than map understanding. At Harvard Project Zero Howard Gardner, David Perkins and their associates have begun to investigate the genesis and development in domains of artistic expression in various media such as metaphoric use of language, the appreciations of art works, etc. We hope to collaborate with Harvard Project Zero in the following way: Their purpose is to provide a description of the levels through which one achieves more and more sophisticated capabilities within a culturally evolved domain; our purpose will be to illuminate the transitions from level to level within and across these domains. Two members of our project have been attending the Harvard Project Zero seminars (including the Principal Investigator) and a staff member of our project has been working informally with some of the staff of the project.

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The manual is intended to make the map drawing instrument available to fellow researchers and interested professionals. A test of the ability of the manual to communicate with fellow researchers was achieved as part of our cross-cultural collaborative study with Dr. Gavriel Salomon and his associates at Hebrew University. During November of the funding year, Ms. Leorah Wellner visited our project and was trained by our staff to administer and score the map drawing instrument. At the same time, Ms. Wellner made comments and suggestions on the draft of the manual. Based on this experience, the manual was revised and enlarged, and the product is one which we now believe may be distributed to colleagues. By the end of the next funding year, we will have received further advice from those who have used the instrument.[3]

The instrument itself perhaps deserves further description. It provides an estimate of the general developmental level of a subject's map drawing performance in relation to a Piagetian developmental sequence of six stages or steps. In addition, the instrument provides a measure of "dispersion" in responses to the demands of the task of drawing a map. It is this "structural mixture" feature of the instrument that makes it particularly useful for studying developmental processes. The levels are presumed to be in an invariant sequence and to be achieved during the years of approximately 7 through 15. Indeed, among adult subjects, map drawings are generally not at the most sophisticated level in the sequence. In this respect, the developmental sequence is somewhat

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[3] If reaction to the map drawing task is favorable, we have made tentative plans to produce audio-tape instructions on how to use the instrument. Presumably, this project would be carried out with funds from other sources.

similar to Professor L. Kohlberg's moral judgment stages, in that the final stages are generally not achieved even by intelligent adults (Kohlberg & Turiel, 1971).

The major advantage of the map drawing instrument over others available is its ease of administration and scoring. The Kohlberg moral judgment sequence is the best known alternative, also based on a Piagetian conceptualization, but the Kohlberg protocols are very tedious to score and require special training. Our hope is that many of the same developmental issues that interest those who study moral judgment and reasoning can be more conveniently investigated through the use of the map drawing instrument. The domains of the two instruments are different, to be sure; but the processes governing movement from level to level are presumed to be analogous.[4]

At least during the next funding year and very probably beyond, we intend to concentrate on domains of knowledge that have either been studied by Piaget (but that also are implicated in existing curricula), or to look to other investigators who have begun to study culturally significant domains in a developmental manner (for example, the people at Harvard Project Zero).

Our objective for the coming funding year in the area of instrument production is to continue to refine the map drawing instrument, while at the same time exploring other possible areas of importance that could be rendered into a developmentally based sequence. In particular, we plan to produce at least one additional measure that can be used at least on a pilot basis by the end of the second funding year.

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[4] Dr. Mordecai Nisan of Hebrew University, a former student of Kohlberg's has expressed interest in using the map drawing instrument to study developmental change. Presumably, during the next funding year, we will have a better sense of how useful the instrument is found to be by colleagues such as Dr. Nisan.

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Theoretical/Conceptual Papers.

During the funding year two theoretical/conceptual papers were completed, one of which is in press (Feldman, 1974), the other is currently under consideration by an educational journal. Copies of these papers are attached to this report and may be found in Appendix D. In addition to these papers, which related rather closely to the conceptual underpinnings of the project, one other paper was written with support from the project's funds. This paper was written with Dr. Brenda Steinberg of the Department of Psychology at Tufts; a copy of the manuscript is also included in Appendix D. (Steinberg & Feldman, 1974).

Since the concept of crystallization is unfamiliar to other investigators, it has been of considerable importance to the project that the ideas introduced in the proposal be given expression and explication. Thus, the writing and publishing of theoretical/conceptual papers is seen as integral to our efforts. A second reason for producing papers is for our own purposes, for clarifying, refining, distilling and elaborating the ideas that have guided and will guide our work. We find that working on the concepts we use through writing about them is an effective method of sharpening our thoughts. We hope to produce two additional papers during the coming year, one which will present the notion of crystallization in an expository manner, the second dealing more narrowly with the nature of spatial reasoning as it is revealed in map drawing and map understanding (Feldman; Snyder, Salomon & Feldman, in preparation).

The two papers now available for distribution may seem to be only remotely related to the main thrust of the project; this is not the case. One of our concerns about a Piagetian model of development, for example,

is that it presupposes that universal advances in intellectual structuring provide an appropriate model for nonuniversal processes of change as well. As we see it, the "nonlinearity" theme gives expression to our belief that models other than the "linear" view promulgated in developmental psychology may have to be constructed to describe achievements and advances that are of a less than universal character, despite the fact that many of the processes governing developmental change may be similar.

The other paper, "Universal to unique: A developmental view of creativity and education," is actually two papers in one. The first part is a critique of existing approaches to creativity, with particular emphasis on the shortcomings of a trait view. A second part of the paper attempts to draw an analogy between Piagetian stage advances and creative insights, a theme pursued by Duckworth (1972) and expressed in a recent book about Darwin by Howard Gruber (Gruber & Barrett, 1974). Finally, an abbreviated account of crystallization is offered to provide a conceptual framework to encompass <u>all</u> significant developmental advances from universal to unique (i.e., from Piagetian to creative). One of my activities for the year will be to separate the first two parts of this paper from the third, with each section becoming a paper which will stand on its own.

This last undertaking is actually part of a more ambitious effort which is now in the early preparation phase. Howard Gardner and Gavriel Salomon, among others, have suggested to me that I elaborate and extend some of my essays into a small book appropriate for a general audience. I have begun preliminary negotiations with an editor and a publisher and should know within the next several months whether or not the prospects for such a book are promising. If so, I would plan to take part of the

09013

summer term to work on the essays, assuming that this activity is acceptable to the Foundation (It was not specifically proposed as part of the funded research; it does, however, maintain the spirit of the original proposal which aimed to communicate through writing the ideas that underlie the project). It is too early to say for sure if the writing of a book is a viable undertaking, but I wanted to report to the Foundation that there is a fair possibility that I may request guidance as to how best to proceed.

Whether or not I actually produce a small book on the subject of crystallization, I plan to continue writing theoretical papers that attempt to make the thinking process explicit as well as to communicate ideas to colleagues. I see this aspect of the project as essential to our empirical efforts, each enriching the other. An example of how this reciprocal enrichment takes place may be found in our main effort for the coming year: a conceptual/empirical study of precociousness in music, art and chess.

The Precociousness Study.

One of the insights that came from our conceptual work on crystallization is that precociousness does not seem to fit very well into the Piagetian account of general intellectual development. In precocious mastery of a complex domain of knowledge and skill, individuals seem to "run ahead" of their general physical and (perhaps) their general psychological development. Our aim during this funding year is to launch, and hopefully complete in at least preliminary form, a study of the generalizability of precocious mastery to other domains. Our hypothesis is that there is little generalizability across domains, which, if true, will be very hard for Piagetian theory to explain. It is, however, reasonable from

39611

the point of view of crystallization. Crystallization allows for the remarkable confluence of individual capabilities and evolving bodies of knowledge. Since every field or domain has a history of idiosyncratic contributions which have accumulated over time, it follows that all fields represent a selected accumulation of such achievements. And it also follows that some individuals will be better tuned to various bodies of knowledge than others, indeed, that some individuals are even occasionally "pretuned" to connect with and express themselves through an existing domain as if they were "made for it." This is what occurs in precociousness, and it is perfectly plausible within crystallization theory.

For the study, our first task will be to review the literature on precociousness, to see what related work has been done. Then we plan to write a review of this literature from the point of view of crystallization theory, illustrating with the example of precociousness the advantages of our point of view and the limitations of the Piagetian framework. Our aim would not be to in any way weaken or challenge the contribution of Piagetian work, but rather to show that some important intellectual phenomena do not fit very well within it. Crystallization is therefore intended to be an adjunct, a compliment, to existing knowledge rather than an attempt to supplant it. It should be noted, however, that one basic assumption of Piagetian theory is that "structures as a whole" are the sources of change; thus, if a child is capable of a task which requires, for example, formal operations, then the child should have available the formal operational structures for other tasks. Our hypothesis of little generalization, if supported, would call into question this one basic premise of Piagetian theory. What the implications of our findings might be for the Piagetian view as a whole are not yet clear, but the possibility that the adequacy of at least this one aspect might be questioned must be considered.

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Having completed our review and refined our hypotheses, we then plan to gather a sample of precocious children from the Boston metropolitan area. When I use the term "precocious" I mean a child who has demonstrated truly remarkable achievements for his age, e.g., master level chess by age six or seven, complex compositions in music or sophisticated verse or prose by the same age. Our plan is to test generalizability both within and across domains, as well as in more general intellectual and emotional development areas (here we find a further use for our map drawing task).

Through this study, as well as through our other work, we hope to gain increased information about the conditions under which remarkable intellectual advances take place, advances that are remarkable both in the sense that they are impressive to members of one's culture as well as remarkable in that they are the occasion for wonder and awe for the individual. In this study as in others, none is a direct test of "crystallization" itself; all are aimed to provide some of the information requisite to such a test, and in that sense they contribute to the overall purpose of the project.

Conclusion.

The goal of our work on crystallization is to illuminate the conditions under which important developmental advances occur, especially advances which would probably not occur without educational assistance. Each activity undertaken by the project is selected for its likely contribution to this overall objective. While it is much too early to say for sure, I am encouraged by our progress to date. We have begun to explore developmental change processes, to identify culturally valued knowledge that may also be developmentally significant, to produce practical instruments for diagnosing readiness for developmental advance, and to further our own thinking about crystallizing conditions and their possible educational relevance. In short, we have made a beginning.

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00017

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